Chapter 5
A New Optimization Method for Supplier Evaluation in the Context of Volume Discount

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ABSTRACT

Supplier selection is a multiple criteria decision making problem that the selection process mainly involves evaluating a number of suppliers according to a set of common criteria for selecting suppliers to meet business needs. Suppliers usually offer volume discounts to encourage the buyers to order more. To select suppliers in the presence of both volume discounts and imprecise data, this chapter proposes an optimization method. A numerical example demonstrates the application of the proposed method.

INTRODUCTION

Managing the purchasing task in the supply chain has been a challenge in the last decade for many corporations. The need to gain a global competitive edge on the supply side has increased substantially. Particularly for companies who spend a high percentage of their sales revenue on parts and material supplies, and whose material costs represent a larger portion of total costs, savings from supplies are of particular importance. Moreover, the emphasis on quality and timely delivery in today's globally competitive marketplace adds a new level of complexity to outsourcing and supplier selection decisions. These, strongly urge for a more systematic and transparent approach for supplier selection. Selecting the suppliers systematically reduces the purchasing cost and improves corporate competitiveness, which is why many experts believe that the supplier selection is the most important activity of a purchasing department (Farzipoor Saen, 2007). Supplier selection is the process by which suppliers are reviewed, evaluated, and chosen to become part of the company's supply chain.

Shin et al. (2000) argue that several important factors have caused the current shift to single sourcing or a reduced supplier base. First, multiple sourcing prevents suppliers from achieving the economies of scale based on order volume

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and learning curve effect. Second, a multiple supplier system can be more expensive than a reduced supplier base. For instance, managing a large number of suppliers for a particular item directly increases costs, including the labor and order processing costs to managing multiple source inventories. Meanwhile multiple sourcing lowers overall quality levels because of the increased variation in incoming quality among suppliers. Third, a reduced supplier base helps eliminate mistrust between buyers and suppliers due to lack of communication. Fourth, worldwide competition forces firms to find the best suppliers in the world.

Traditionally, supplier selection models were based on cardinal data with less emphasis on ordinal data[1]. However, with the widespread use of manufacturing philosophies such as Just-In-Time (JIT), emphasis has shifted to the simultaneous consideration of cardinal and ordinal data in supplier selection process. Suppliers usually offer quantity discounts to encourage the buyers to order more. The objective of this chapter is to propose an innovative algorithm for selecting suppliers in volume discount environments in the presence of both cardinal and ordinal data.

LITERATURE REVIEW

Some approaches have been used for supplier selection in the past. Kahraman et al. (2003) used fuzzy Analytic Hierarchy Process (AHP) to select the best supplier providing the most satisfaction for the criteria determined. To take into account both cardinal and ordinal data in supplier selection, Wang et al. (2004) developed an integrated AHP and preemptive Goal Programming (GP) based methodology. However, AHP has a main weakness. AHP could not include interrelationship within the criteria in the model[2].

To solve the vendor selection problem with multiple objectives, Kumar et al. (2004) applied a fuzzy GP approach. To incorporate the imprecise aspiration levels of the goals, they formulated a vendor selection problem as a fuzzy mixed integer goal programming that includes three primary goals: minimizing the net cost, minimizing the net rejections, and minimizing the net late deliveries subject to realistic constraints regarding buyer's demand, vendor's capacity, vendor's quota flexibility, purchasing value of items, budget allocation to individual vendor, etc. However, one of the GP problems arises from a specific technical requirement. After the purchasing managers specify the goals for each selected criterion (e.g., amount of price, quality level, etc), they must decide on a preemptive priority order of these goals, i.e., determining in which order the goals will be attained. Frequently such an a priori input might not produce an acceptable solution and the priority structure may be altered to resolve the problem once more. In this fashion, it may be possible to generate a solution iteratively that finally satisfies the decision maker. Unfortunately, the number of potential priority reorderings may be very large. A supplier selection problem with five factors has up to 120 priority reorderings. Going through such a laborious process would be costly and inefficient.

Weber (1996) demonstrated how Data Envelopment Analysis (DEA) can be used to evaluate vendors on multiple criteria and identified benchmark values which can then be used for this purpose. Braglia and Petroni (2000) described a multiple attribute utility theory based on the use of DEA, aimed at helping purchasing managers to formulate viable sourcing strategies in the changing market place. Weber et al. (2000) presented an approach for evaluating the number of vendors to employ in a procurement situation using Multi-Objective Programming (MOP) and DEA. The approach advocates developing vendor-order quantity solutions (referred to as supervendors) using MOP and then evaluating the efficiency of these supervendors on multiple criteria using DEA. To evaluate the aggregate performances of suppliers, Liu et al. (2000) proposed to employ DEA. This extends Weber's (1996) research in using DEA in supplier evaluation for an individual product.

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